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**CREATIVITY IN EDUCATIONAL PROCESS WITHIN THE
FRAMEWORK OF QUANTUM-INFORMATION MODEL**

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Abstract

Russia faces situation of lacking specialists with creativity skill, what leads to the issue of developing creativity within the education process. Solution is connected to understanding the way mind supports creativity. Paper is defining the role of conscious and unconscious mechanisms of mind in creativity and analysing creativity based on quantum-information model of mind. Ontology base of creativity within the quantum-information model of mind is defined. Based on results we propose potential technologies that allow to discover creativity potential of educational system and adjust process of its update. Theory-methodology basis of the research is a concept of social processes synergy together with philosophical anthropology concept which suggests quantum-information model of mind that treats mind's experience as a result of decoherence of superfined mind's possibilities of unconscious nature. In the analysis next research methods are used: phenomenological method, axiomatic-deductive method, dialectical method. In the summary creative activity of mental subject is provided by the transverse information causality. Psychological basis of creative process is the mechanism of assimilation, through which the information coming from outside is transformed in accordance with personality characteristics of the subject. Proposed model opens the opportunity of influencing the identification and development of the creative potential in the reformed education system.

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1. Introduction

Current time is characterized by the rapid development not only of the technical capabilities of the society, but also of humanity nature itself, its way of thinking, feelings and motives. Humanity's activities are changing; requirements to the skills level, to the methodological culture, to the ability to non-traditional innovative solutions and to the creative approach in the implementation of the theoretical and practical tasks are increasing.

Thus, today Russian education system faces an urgent needs in preparing professionals who possess the creative component and in developing of creative skills within the existing educational process framework. The solution of this problem lies in the ontology of the mental and in the understanding of how the conscious and unconscious mechanisms of the psyche are enabling creative activity of the subject.

2. Problem Statement

The paper proposes a quantum-informational model of psyche, in which existence of conscious and unconscious mind are looked at from the standpoint of quantum ontology. Accordingly, the unconscious mind is considered as a superposition of possible mental states that are transformed on the mental level of existence into an experienced from within mental state of the classical type. The creative act is based on the mechanism of assimilation, which converges into a change in the representative structure, when it flexibly and harmoniously is embedded into the mental experience of the subject, forming single entity with the existing structures of the subject.

3. Research Questions

The paper examines the quantum-information specificity of mental acts, and creativity in the educational process is considered as a form of mental activity of the subject, determined by transverse information causality.

4. Purpose of the Study

The quantum-information model of the psyche is based on the principle of superposition, which stipulates that the existence of a quantum object is of potential character and represents the distribution of the possibilities of existence in a particular state. At the same time uncertainty quantum phenomena, as demonstrated in experimentally confirmed violation of Bell inequalities, is caused not by insufficient information about the values of the parameters defining the existence of the object (as it happens, for example, in the statistical thermodynamics), but by its essential nature. Following Aristotle it is appropriate to introduce the definition of real and possible existences of material systems. Real existence (or existence-in-reality) is defined by existence of some material event in current location and current time, which does not conflict with the presence of another event in the same location and the same time. Possible existence (or existence-in possibility) is defined by the existence of some the material event in current place and current time, the presence of which is in conflict with the presence of other material events at the same place and the same time. If the material object exists in reality, it has non-conflicting to

each other features. If the material object exists in possibility then it has conflicting properties, which are allowed precisely because these properties exist potentially, and not in reality.

5. Research Methods

This paper uses phenomenological method to describe the psychological basis of creativity. In constructing a quantum-information model of the psyche, an axiomatic-deductive method and a method of conceptual analysis are used.

According to quantum-information ontology material system before observation (i.e. before its interaction with other material systems) is in a superposition of possible states described by a wave function, whereas after observation (i.e. after its interaction with other material systems) occurs decoherence (collapse of the wave function), whereby one of the possible states becomes valid while all the others disappear (Cherepanov, 2017, p. 148). The central idea here is Aristotle's division into existence-in-the possibilities and existence-in-reality, because, as Aristotel states in his "Metaphysics": "in the possibility the one and the same can be together as mutual opposites, but in reality they cannot" (Aristotle, 1976, p. 135). Many thinkers were using this idea to build quantum ontology. For example, V. Heisenberg points out that "Mathematical laws of quantum theory can be considered as quantitatively formulated Aristotelian concept of "dynamis" or "potency" (Heisenberg, 1987, p. 223). Famous Soviet physicist V. A. Fok in order to explain the dependence between physical states of quantum system and means of its experimental measurement introduces terms "potential possibility" and "happened". In "Interpreting quantum mechanics" A.U. Sevalnikov also emphasizes that the analysis of the philosophical foundations of the quantum-mechanical picture of the world brings us back from the Cartesian understanding of matter as a substance to Aristotle's understanding of matter as a possibility.

The being exists in the possibility because it is not interacting with another being and remains closed in itself. Being exists in reality insofar it interacts with the others and is not closed in itself. Being closed in itself, which exists in the possibility, is not separable into individual elements and exists as a single (non-separable) material entity. In decoherence process, which is caused by interaction with another being, observed being switches from the possible existence into real existence, thereby acquiring an internal structure and disintegrating into its constituent elements. In the reverse recorence process due to rupture of the causal connections between observed being and another being, it switches from possible existence to real existence, thereby acquiring integrity and losing internal structure, what allows to separate it into individual parts.

In order to preserve the determinism of material events within the framework of the quantum information ontology causality is divided into longitudinal and transverse. Longitudinal causality determines linear sequence of physical events, when the past physical event serves as the cause, and the future as a consequence in relation to physical events occurring in real time (Chalmers, 2013, p. 218). Transverse causality determines the choice of a single option from a set of superponed possibilities, when the quantum world transforms into a classical one and some of the information about the previous state of the physical system is lost.

Longitudinal causality has a physical character and is described by the equations of physical science. In contrast, transverse causality does not have a physical character and cannot be described by

the equations of physical science, because if there was a quantum event Y_i^j (which has a correspond possibility p_i^j) from a set of superponed possibilities $Y_i^1, Y_i^2, \dots, Y_i^{N_i}$ (and the probability p_i^j can take the smallest value), then no laws of physics can explain why event Y_i^j happened, and not any other from the set of superponed possibilities $Y_i^1, Y_i^2, \dots, Y_i^{N_i}$. Consequently, the reason for the collapse of the superposition of possible states is not of a physical but of an informational nature, what does not allow the existence of hidden parameters by means of which it would be possible to converge the transverse causality into the longitudinal one.

As a result of observations of the behaviour of the quantum system, i.e. its interaction with some other physical systems in the surrounding world, a set of possible states is being destroyed and only one state remains, while all the others disappear without a trace. Thus, the quantum object becomes classical, i.e. begins to demonstrate physical properties that do not contradict each other in the framework of formal logic. In the decoherence process, which is caused by interaction with another being, observed being switches from possible existence to real one, thus obtaining internal structure and disintegrating into constituent elements. In the reverse process of the recoherence, caused by rupture of causal relations between observed and another being, it moves from real existence into possible one thus gaining integrity and losing internal structure, what allows to separate it into separate parts.

The physical being before interaction with another physical being is in a superposition of possible states $(A_1^1, A_2^1, \dots, A_{n_1}^1)$, each of which is assigned a certain probability $(p_1^1, p_2^1, \dots, p_{n_1}^1)$. After interaction with another being and accumulating sufficient information of an operational type decoherence occurs, and as a result only one state A_i^1 , with its assigned probability p_i^1 , remains, and on the level of the observed being the information about all the other states is irretrievably lost. Then the energy-information exchange between physical being and environment is reduced, and it is recohering again into a superposition of possible states $(A_1^2, A_2^2, \dots, A_{n_2}^2)$, each of which is assigned a certain probability $(p_1^2, p_2^2, \dots, p_{n_2}^2)$. And so it continues as long as the physical being exists (Figure 1). Every physical state $A_1^i, A_2^i, \dots, A_{n_i}^i$ correlates with information that, same as a physical being, can exist either in superposition of possible states, or in a single real state.

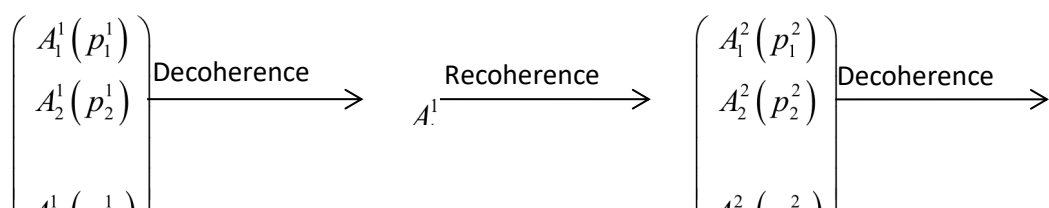


Figure 01. The formation of the physical being

The situation changes dramatically on the mental level of existence, where the decoherence and recoherence processes run in parallel, because a mental state B^i is associated with the superposition of possible states of unconscious nature ($B_1^i, B_2^i, \dots, B_{n_i}^i$), each of which is assigned with certain probability ($p_1^i, p_2^i, \dots, p_{n_i}^i$). In other words, every mental state B^i corresponds to n_i information states, which it symbolically indicates and which with a certain probability can be demonstrated in a corresponding mental context (Figure 02). Thus every mental event in the temporal flow of consciousness is accompanied by a superposition of unconscious mental states.

In accordance with the scheme shown in Figure 01, the physical being that is decohering in interaction with the environment is in a single classical state, whereas according to the scheme shown in Figure 02, the mental being, decohering in the interaction with the environment, is in a unique classical state on a conscious level of existence, and in a superposition of quantum states on the unconscious level of existence, what justifies the evolutionary value of the mental experiences and allows the psychic being, unlike beings who do not have mind, exhibit a more diverse and adaptive behaviour. Physical system when the transiting from the quantum state into a classical one loses information packed together in a set of superponed possibilities, while psyche system during the same transition saves information packed together in a set of superponed possibilities that exist on the unconscious level of the mind, and therefore, it has greater opportunities, and, consequently, greater behavioural diversity. In other words, a more diverse and adaptive behavior of systems, that have gained mental experiences from within, is enabled by the parallel course of decoherence and recoherence processes on a psyche level of existence; in contrast to physical systems, that are characterized by the consecutive flow of decoherence and recoherence processes.

The presence of consciousness indicates that there are two types of observer access to the observed beings - dissociative and associative. Dissociative access refers to the separation (dissociating) of the observer and the observed being on the physical level of existence. Associative access assumes the unity (association) of the observer and observed being on the physical plane of existence. Based on the above, there are three types of observers in connection to their ontological status: 1) transcendent observer, 2) immanent observer and 3) transcendental observer. Transcendent observer is not part of the observed system and does not interact with it on physical level of existenc, i.e. he/she does not have neither dissociative nor associative access to it. Immanent observer is a part of the observed system and interacts with it on the physical level of existence, i.e. has dissociative access to it. The transcendental observer is observed system itself, i.e. has associative access to it.

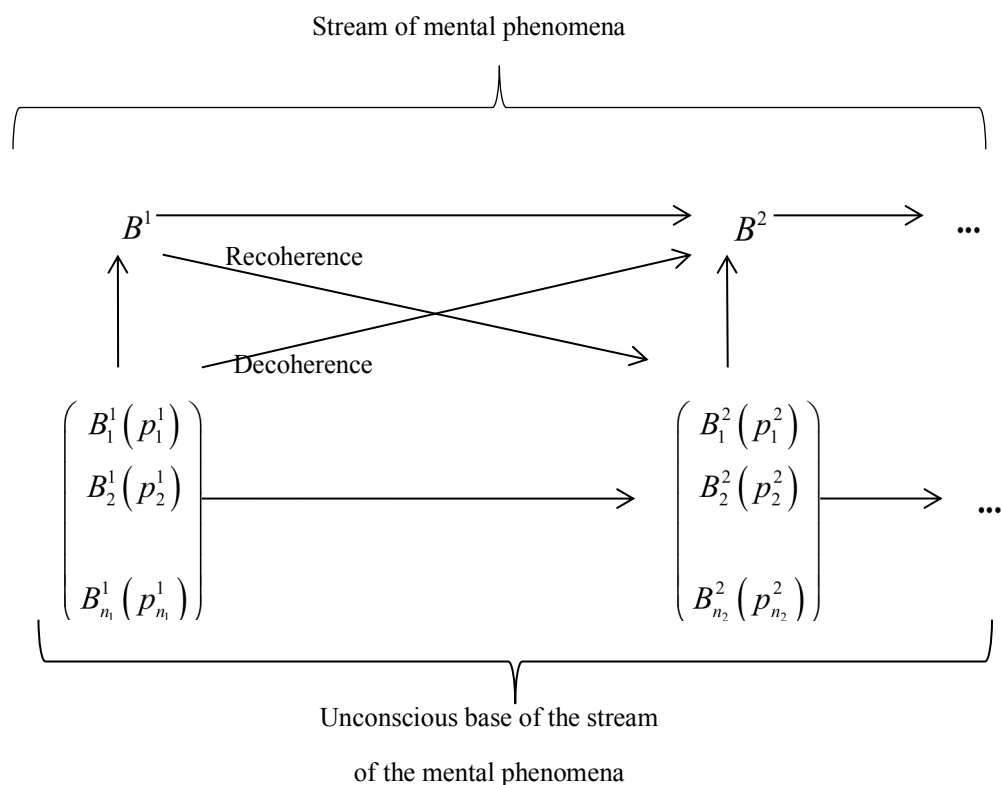


Figure 02. The Emergence of the Mental Being

The quantum-undefined nature of the unconscious mind makes it possible for the simultaneous existence and development of contradictory ontologies of the psychic being (such as psychoanalysis of Z. Freud, analytical psychology of Carl Jung, logopsychology of V. Frankl, psychosynthesis of R. Assagioli, humanistic psychology of A. Maslow, gestaltpsychology of F. Perls, existential psychology of I. Yalom, dasein-analysis of M. Boss, transpersonal psychology of S. Grof or transact analysis of E. Berne). In particular, various psychological concepts are based on different ideas about the fundamental motive of human life. For example, Z. Freud recognizes the sexual desires as a fundamental motive, K. Horney - the pursuit of safety, A. Adler - the pursuit of excellence and power, V. Frankl - the pursuit of meaning, A. Maslow - the desire for self-actualization, K. Rogers – pursuit of personal integrity and I. Yalom believes that on the unconscious level of existence human life is driven four fundamental fears - fear of death, fear of loneliness, fear of meaninglessness and fear of freedom, and F. Perls argues that generally it is inappropriate to talk about the fundamental motive of human's life, since any dominant need can act as such. However, all these psychological concepts are still being equally effective in the context of psychotherapeutic work with specific personality despite differently interpreting human behaviour.

We conclude that the unconscious mind is determined only in the space of conscious interpretation, existing before the ontological collapse in the form of possibilities distribution of mental experience, identical to how the quantum system exists in a superposition of states before the empiric measure. It is possible to say that unconscious mind has a quantum existence in a sense that any mental ontology taken in its unique essence, represents the realization of one of the not realised opportunities of mental existence of an individual, just as the classical world represents one of several not realised

possibilities of quantum existence before its interaction with measurement equipment (i.e., until the moment there is sufficient amount of information generated allowing to reduce quantum superposition of states).

Mental functions of consciousness by which it differs from unconscious mind, can be identified as: 1) amplification, 2) a filtration and 3) reduction. Amplification complements the emergent entity with a collection of elements of the mental field. On the level of unconscious mind there are no strictly defined emergents, because unconscious experience represents a distribution of a plurality of undeveloped mental experiences with potential existence. And only on the level of consciousness when many undeveloped mental experiences collapse in the single truly demonstrated state, strictly defined emergents of mental experience are formed as holistic structures, that cannot be reduced to the simple sum of the elements, whether it is sensible emergents (images and beliefs that are not reducible to a simple sum of the feelings), or intellectual emergents (ideas and concepts that are not reducible to a simple sum of the semantic content of symbols, through which these ideas and concepts are expressed).

Due to filtering only small piece of information existing at unconscious level gets into mental area of mind. Consciousness filters repressed (resisting the forces of mental field) unconscious, selecting from all potentially existing distribution, mostly those experiences that do not enter into destructive (painful) conflict with processed mental material. As a result, the repressed unconscious transforms into preconscious (not resisting the forces of mental field and open to the mental subject by the action of transverse information causality) which can be amplified in conscious phenomena.

Due to the reduction the potential existence of the unconscious, mind is realized in a form of real existence of mental phenomena. In this case, there is analogy with the reduction (collapse) of the wave function in quantum mechanics, when as a result of measurement conducted on a quantum object superposition of ontological capacity is reduced to a single realised state. In accordance with the quantum-information theory, the reducing function of consciousness realises one of the ontological possibilities that correlate with the neural code in the human brain (which, in particular, determines the plurality of mental ontologies).

On a mental level reduction is an intermediate stage between the filtering and amplification, because it uses filtered possibilities to select realised state, and then amplified forces are completing construction of mental elements till integral mental phenomenon. In the beginning, filtering is carried out (in the process of which some mental states, that come into conflict with consciously understood material are blocked at the level of the unconscious mind, and others - become preconscious, i.e. accessible for the transition from possible existence into real one), then - reduction (in the process of which one of the possible preconscious states is realised on a mental level of existence) and finally - amplification (in the process mental emergents are formed out of disparate elements of mental experience). Interaction of mental emergent, demonstrated in the dynamics of figure and background, helps in changing the filter factors, whereby preconscious material is filled with new potential phenomena, and reduction leads to new mental states, generating new mental emergents. As a result, three main mechanisms of mental existent - filtering, amplification and reduction - provide the diversity and richness of the inner life of the subject, building up dynamics of mental phenomena over the unconscious mind.

Thinking of animals is unconscious in nature, and their behaviour is the result not of meaningful judgments, but of unconscious insights connected with spontaneous restructuring of the field of conscious perception. And only on the level of social existence, human thinking, which is characterised by creation of meanings in the conscious sphere of mind, is actually revealing itself. It follows that the human thinking potentially exists in the mental activity of the animals, but is not realised on the conscious level of the mind what, in certain situations, makes us to project human mental states onto animals.

One of the most important and socially significant emergent, human is seeking to complete throughout the life, is personal integrity rooted in harmony (authenticity) of mental life, i.e. in the absence of contradiction between the sensible, intellectual and behavioural levels of human existence. In other words, balanced (authentic) human existence means that he/she experiences own (assimilated rather than introjected) feelings, expresses own (assimilated rather than introjected) thoughts and performs own (assimilated, not introjected) actions. At the same time, his/her feelings do not contradict to thoughts, ideas do not contradict to actions and actions do not contradict to feelings. Thus, the effect of amplifying forces in the field of mental experience conditions pursuit of personal integrity as constitutive characteristic of social human existence, what, in particular, existentially oriented philosophers and psychologists say, e.g., E. Fromm, K. Rogers and A. Maslow.

Based on the considerations above, non-understanding and understanding consciousness should be separated. Non-understanding consciousness represents a testimony of phenomenal quale but without fastening them into a single perceived mental entity of intentional objectivity (i.e. realised sense). This consciousness is peculiar to animals and infants that distinguish individual objects, but do not understand what they are see, as well as to adults that for the first time confront with something for which they don't corresponding words and concepts. Understanding consciousness involves awareness of meaning, which is packed in a system of representative symbols, intentionally pointing at a meaningful subject (Chernikova, 2016, p. 105).

In turn, a non-understanding consciousness can be understood in two main senses: 1) as associative knowledge i.e. aggregation of mental experiences, not correlated to intentionally supposed object a conscious level of existence, and 2) as the dissociative knowledge, i.e. aggregation of mental experiences, correlated on a conscious level of existence with intentionally supposed object that is not identified in as a symbolic structure (in the form of meaningful concepts). Understanding consciousness can also be understood in two main senses: 1) as a dissociative understanding - a set of mental experiences and correlated on a conscious level of existence to intentionally supposed object, which is identified as a symbolic construction (i.e. a meaningful concept), and 2) as an associative understanding - a set of mental experiences and correlated on a conscious level of existence to intentionally supposed object, which is also identified as a symbolic construction (i.e. a meaningful concept).

Consciousness as an associative knowledge represents a fixation of a phenomenal content that is built over the processes of neural nature, but is not converged to it in existence (Baryshnikov, 2014, p. 100). This consciousness raises the question, about the fact what it is - to experience various sensory data, but has non-intentional (not subject specific) nature, because it does not allow us to say anything certain in relation to 1) object of experience (which is represented by the aggregation of phenomenal quale, data in the experience) and 2) subject of the experience (which is experiencing a set of phenomenal quale, data

in the experience). There is still no division into inner and outer existence, i.e. on not-me and me. Associative knowledge consists of elementary sensations (e.g., experiencing pain, sound, color, odour or taste), which do not embody any indication of the represented object or basic emotions like elementary sensations complexes (e.g., experiencing fear, joy or anger), which express psychic reactions to certain circumstances with no reflection to the latter from the experiencing subject (Ivanov, 2013, p. 98).

Consciousness as dissociative knowledge represents fixation of plurality of qualitative phenomena (quale) in the objective unity of the temporal stream linked to experienced subject. In the act of dissociative cognition set of phenomenal qualities is related to intentionally assumed object, which is identified only because his representation is accompanied by certain sensory experiences without any semantic (symbolic) components. At this point division into external and internal existences appears, i.e. on not-me and me in their ontological unity, i.e. in the temporal unity of the conscious subject. Dissociative knowledge includes sensory images, by means of which external state of the represented object or internal state of representing system is demonstrated (Levin, 2015, p. 146).

Consciousness in the modus of dissociative and associative knowledge inherent to animals, but not to cybernetic systems because the latter perform logical-computational actions, and are not in intentional or the qualitative states that are peculiar to the mental level of the information data.

Consciousness as a dissociative understanding reveals the meaning of the set of experienced qualities that make up a single ontological entity. In such consciousness knowledge about the object is present; the object is contrasted with conscious subject and intentionally provided not as information aggregation of experienced data but as the referent intellectual (symbolic) construction. If the associative and dissociative knowledge has degenerated longitudinal and transversal intension, then dissociative understanding has non-degenerate longitudinal and transverse intension, because it captures in the meaning the information about some of the represented object or representing subject itself. Within the dissociative understanding a symbolic (abstract-conceptual) representation of the world existing in reality, as well as non-existing (imaginary) worlds, is formed, i.e. there is a division into real and potential existence (Belyaev, 2015, p. 49). This level of consciousness is not available to animals, because they represent the world, but don't represent possible ways of representation and cannot distinguish possible from real. Consciousness as a dissociative understanding depends on information data exchange between interacting subjects and cannot be developed in the social isolation.

On the level of associative understanding conscious subjects are transcending their own ontological boundaries, forming an idea not only of who they are but also about whom they should be and what is the ideal of conscious existence. At this moment conscious subjects choose themselves in a variety of symbolic spaces (culture, art, religion or science) generated on the level of dissociative understanding, and change their existence in accordance with the mentally assimilated ideas and values (Dennett, 2004, p. 54). The self-determination of the conscious subject has an existential character, because in the process of conscious self-determination forms of representation are identified with forms of existence of the conscious subject.

Actualization of representative constructions as an ontological forms can have two opposite sides, one of which involves taking a representative structure intact when it firmly and rigidly is embedded in the psychic experience subordinating existing structures or engaging with them into conflict interaction,

and the other, on the contrary, includes change of representative structure, when it is flexibly and harmoniously integrated into the subject's mental experience, forming a consistent unity with the already existing structures. In the first case, we are talking about the introjection of representative forms, and in the second about their assimilation (Razeev, 2016, p. 154). Between introjection and assimilation there is an accommodation, which is modifying old experience under the influence of the new one and which reconciles the two extreme poles of identification of the forms of existence and forms of self-experience. It reaches maximum in the process of introjection of representative forms, when introject, without undergoing modification, starts to affect psychic experience as a whole. For example, the introjection of the belief that if the person is loved, then he/she is safe, and if person is not loved then he/she is in danger, or beliefs that if a person is loved, then he/she exists, and if person is not loved, then he/she does not exist, leads to the situation when a person starts looking for love in any situation and wants to please absolutely everyone, even those who dislike him. Accommodation reaches its minimum, in the process of assimilation of representative forms, when the latter are modified so much that they lose their original essence and are completely reduced to already known experience (Vasiliev, 2014, p. 178). For example, assimilation of mythology by means of scientific philosophy leads to depreciation of myth's existential component and reduces it to simple fairy tales, legends and parables that do not have a real relation to the existence and are torn off from reality by symbolic forms of cognition. Complete assimilation of one culture in another leads to a destruction of the essence of the first one, losing its unique representative structures that ensure constituent of existence identity and thinking, and, for example, this happens in a dialogue of different religious philosophies, each of which claims to be absolute and unshakable knowledge about the world. Accommodation reconciles the two extremes representatives, on the one hand, preserving previous experience, and, on the other hand, introducing a new, creative experience, and as a result new knowledge is not reduced to the old one and old knowledge is not completely replaced with a new one. Therefore accommodation provides creative action as an effective dialogue between two different views of the world that are based on the incompatible principles.

On the level of dissociative understanding processes of projection are initiated, whereas on the level of associative understanding conscious subject becomes capable of assimilation and accommodation, making it free and self-determined being or, in other words, creative. Creative subject on the level of associative understanding feels dissatisfaction with itself and seeks ways to transform itself to become better and this is not inherent to animals in any form, because they don't feel conscious dissatisfaction with own existence and do not understand the spiritual ideal to pursuit. Therefore, the existence of mankind differs from the existence of animals by the symbolic and transcending nature.

Creativity as an innovative process can be genuine and not genuine. Not genuine creativity, which ancient Greek philosophers denoted with the word τέχνη, represents development of new stereotypes of material system behaviour under consideration that are not driven by the processes of assimilation (Morgunov, 2012, p. 104). In contrast, the genuine creativity, which Greek philosophers designated word ποιησις, is the development of new behaviours of material system under consideration that are driven by the assimilation processes. Not genuine creativity is inherent in animals, but the true genuine - only to mankind, what is determined by the associative level of cognitive consciousness, because only this level

allows the rational being to freely manage its own existence and create symbolic worlds that determine its behaviour in real life.

If subject copies the actions of another subject, then it does not go beyond the limits of τέχνη, no matter how perfect the copy created by him. And only expressing itself, its authentic being, bonded into an entity with assimilated emotions and thoughts, the subject is raised to the level of ποίησις, when it really creates something new, unique, corresponding to his free choice.

6. Findings

There are two types of causality, one of which, longitudinal, is of an energetic nature and causes one event to follow another in time space, and the other, transverse, is of information nature and causes the realisation of a single event from a superponed set of events existing potentially.

It is shown that the unconscious mind exists in possibility as a superposition of mental experiences, whereas the conscious mind exists in reality as a realized mental state from the set of possible states of the unconscious order. The unconscious mind is defined in the space of conscious interpretations, existing before the ontological collapse in the distribution of opportunities of mental experience, which allows us to explain the multiplicity of incompatible psychosocial ontologies.

In the classical theory, all functions of the mind are already set, and social relations act as factors of mental development. In the non-classical theory all mental functions are given in the form of social relations that act as base for the emergence of these very functions in people.

Non-classical quantum-informational model of psyche proposed by us explains creativity as a demonstration of the assimilation mechanism, within which representative construction is embedded into the mental experience of the subject, and creates coherent entity with already existing structures. The ontological determinant of the creative process is transverse information causality, which acts in the area of superponed states of possible psychic experience.

7. Conclusion

Therefore, creative activity of the mental subject is enabled with transverse (which determines the causal relationships between events in a superposition of possible states) information causality acting on the boundary between the conscious and unconscious mental life. The psychological basis of the creative process is the mechanism of assimilation, through which the information coming from outside is transformed in accordance with the personality characteristics of the subject.

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